

## **Appendix A**

### **Summary of Silver Bow County Cancer Incidence and Mortality Study (MDPHHS 2012)**

## **Summary of Silver Bow County Cancer Incidence and Mortality Study (MDPHHS 2012)**

As part of the first phase of the Superfund-related health studies and to address broader community concerns, the Working Group identified the need for an update to and expansion of a 2001 ATSDR review of Silver Bow County cancer incidence rates compared to similar data for Montana and the U.S. (ATSDR 2002). The 2002 ATSDR analysis focused on cancer outcomes associated with exposure to heavy metals including arsenic, and, to a lesser extent, lead and mercury. Update of the ATSDR study aligns with public health study activities specified in the RMAP and was prioritized to address heightened concerns about elevated cancer mortality rates in Butte expressed by community members during public listening sessions.

The updated study was conducted by the MDPHHS and included consideration of the most common cancers, as well as cancers associated with exposure to metals present in Butte. The health study Working Group did not provide input to or comment on the state's report (MDPHHS 2012). The MDPHHS study (2012) is attached along with the ATSDR (2002) study. A summary of the MDPHHS (2012) approach and findings is provided below.

In May 2012, MDPHHS, evaluated cancer incidence and mortality among BSB residents using data from Montana death records and the Montana Central Tumor Registry (MCTR). Cancer incidence and mortality rates among BSB residents were compared to state and national rates to assess whether or not cancer is elevated in BSB. Cancers which are diagnosed or treated among Montana residents are required, by state law, to be reported to the MCTR. Similarly, all deaths which occur among Montana residents are also to be reported to MDPHHS. It is estimated that MDPHHS has records of over 95% of all cancers and deaths which occur among Montana residents.

According to MDPHHS, the best way to assess the effects of environmental exposure on cancer risk in humans is to measure cancer incidence. Cancer incidence measures the number of newly diagnosed cancer cases in a population each year. Cancer mortality, on the other hand, is the number of deaths that occur each year from cancer. Mortality reflects both the risk of getting cancer and the ability to get effective diagnosis and medical treatment. Two communities can have similar incidence rates, but very different mortality rates. In fact, a community can have a relatively low incidence rate, but a relatively high mortality rate because of limited access to services. Therefore, incidence rates are the best way to compare the risk of getting a disease and mortality rates are a way to compare access to care and treatment after people become ill.

Cancer is not a single disease. Cancer is actually a general term which includes over 100 different kinds of cancer. Each type of cancer has its own risk factors. The four most common types of cancer are prostate, female breast, colorectal, and lung and bronchus. The cancers known to be associated with exposure to specific heavy metals of concern in BSB are lung and bronchus cancer, bladder cancer, kidney cancer, and liver cancer.



Agency for Toxic Substances & Disease Registry

# Public Health Assessments & Health Consultations

## HEALTH CONSULTATION

SILVER BOW CREEK/BUTTE AREA  
BUTTE, SILVER BOW AND DEER LODGE COUNTIES, MONTANA

## INTRODUCTION

In June 2001, the Montana Department of Public Health and Human Services (MDPHHS) requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate cancer incidence data for Silver Bow County. The MDPHHS and Silver Bow County Health Department have had reports of possible cancer excesses from residents and physicians in the area for many years. This analysis focused on cancer outcomes associated with exposure to heavy metals including arsenic, and, to a lesser extent, lead and mercury.

Historically, elevated environmental levels of numerous heavy metals have been found in Silver Bow County soils as a result of mining and milling practices in the area. The Silver Bow Creek/Butte Area National Priorities List (NPL) site is an extensively contaminated site located in Silver Bow and Deer Lodge Counties. ATSDR has issued numerous documents related to this NPL site including health assessments, site review and updates, and health consultations. The agency has also conducted various health studies and exposure investigations in the Silver Bow area.

The purpose of this data review is to compare cancer incidence rates from Silver Bow County with similar data at the State and national levels. This ecologic analysis does not include any exposure information. Instead, it relies solely on cancer incidence data from state and national cancer registries and population demographic data from the U.S. Census Bureau.

## MATERIALS/METHODS

The Montana Central Tumor Registry provided cancer incidence data to ATSDR in the summer of 2001. This data described all newly diagnosed cases occurring in Silver Bow County and the entire state of Montana during the twenty-one year period from 1979 to 1999. Specific cancer sites analyzed included the urinary bladder, kidney, liver, lung, prostate, and skin. Skin cancers used in this analysis included malignant melanomas as well as nonmelanomas. These outcomes were chosen because of their reported associations with arsenic exposure [1]. Mercury is not considered a human carcinogen and therefore did not influence the choice of cancers being analyzed [2]. There is limited information on the potential for lead to cause cancer so this contaminant also had little influence on the cancer sites analyzed [3].

Standardized incidence ratios (SIRs) were calculated using two comparison groups. The comparison groups included the entire state of Montana and a representative portion of the United States population. The Montana Central Tumor Registry provided cancer incidence data for the state of Montana for the years 1979 to 1999. Cancer incidence data for the United States were obtained from the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) program. The SEER program collects and publishes cancer incidence and survival data from 11 population-based cancer registries and three supplemental registries covering approximately 14 percent of the U.S. population. The SEER data used for comparison in this analysis included cancer incidence from 1989 to 1998.

Cancer incidence data for Silver Bow County and the two comparison populations were standardized using four age groupings; 20-54, 55-64, 65-74, and 75 and over. These predefined age groupings are used in publicly available SEER datasets. Age standardization eliminated the effects of age differences among residents of Silver Bow County, the state of Montana, and the United States as a whole. Cancer incidence rates for the state of Montana were adjusted using 1990 Census Bureau data. United States (SEER) incidence data were adjusted using the standard 1970 U.S. population.

## RESULTS

Skin cancer was the only outcome that demonstrated elevated rates when compared to both Montana and U.S. reference populations (Table 1, Table 2). The SIR for all persons age 20 and over when compared to the state of Montana was 1.23 (95% CI, 1.04-1.44) and compared to the U.S. population was 1.24 (95% CI, 1.05-1.45). There were also elevated SIRs within multiple age-specific categories for skin cancer when compared with both reference populations.

Other cancer outcomes including urinary bladder, kidney, and lung demonstrated elevated rates in some age-specific categories but these elevations were not consistent when compared with both reference populations. Liver and prostate cancer rates were not elevated when compared with either reference population.

## DISCUSSION

A previous ecologic analysis of skin cancer rates in Silver Bow County and neighboring Deer Lodge County by Wong et al. failed to show any significant increases in cancer morbidity [4]. However, their analysis used only six and one-half years of cancer incidence data (1980 to mid-1986) and this analysis looked at cancer incidence over a much longer time frame (1979-1999). Wong et al. identified all skin cancer cases through area pathologists and dermatologists, a less effective method compared with the use of data obtained from the state's central tumor registry. Case ascertainment in this analysis should be significantly increased through the use of registry data.

There are numerous limitations to this ecologic analysis including the potential for in- and out-migration of cases, a lack of exposure data, and no assessment of temporal variables (i.e. were subjects exposed before the occurrence of disease and were these exposures early enough to account for cancer latency). This analysis measured skin cancer incidence in aggregate instead of distinguishing between the two distinct forms of this disease,

malignant melanoma and nonmelanoma. Nonmelanoma is the only type of skin cancer that has been associated with arsenic exposure [5]. However, none of these limitations should consistently bias SIRs towards positive or negative associations.

Another limitation in interpreting the apparent elevation in skin cancer incidence is the demographic difference between Silver Bow County and the U.S. comparison population. Both malignant melanoma and nonmelanoma skin cancers are much more common in white populations. There is a higher percentage of Caucasians in Montana in contrast to the U.S. Therefore, some increase in skin cancer in the Montana population can be expected when compared to the total U.S. population. However, the demographics of Silver Bow County and Montana are fairly similar so this does not explain the elevated SIRs generated through comparisons with state cancer incidence data.

The process for age-adjusting cancer rates in Silver Bow County and Montana were similar as was the time frame for comparison (1979-1999). In comparing Silver Bow County with U.S. rates, there were some discrepancies. The analysis used different time frames of cancer incidence data for Silver Bow County (1979-1999) and the U.S. reference population (1989-1998). Also, there was a difference in the age-adjustment process with the U.S. reference group standardized using the 1970 U.S. population. These discrepancies in age standardization were unavoidable since NCI does not provide the raw data collected through the SEER program.

Even with these limitations and the minor differences in age standardization methods, there appears to be a slight increase in skin cancer incidence in this area of widespread arsenic contamination. Historically, skin and lung cancer have been the most prevalent cancer outcomes associated with arsenic exposure in the public health literature. Unfortunately no dose estimates were available for this analysis so the slight increase in skin cancer incidence cannot be evaluated against potential arsenic exposure in the area.

## CONCLUSION

The data indicate a slightly elevated incidence of skin cancer in Silver Bow County when compared with age-standardized rates at the State and national level. No other cancer outcomes were consistently elevated when compared with these two reference groups. The slight increase in skin cancer incidence cannot be directly attributed to soil arsenic contamination in the area since no exposure assessments were included in this analysis.

## RECOMMENDATIONS

1. Evaluate melanoma and nonmelanoma skin cancer incidence separately since only nonmelanoma skin cancers are associated with arsenic exposure.
2. Educate local citizens on ways to reduce or eliminate exposure to ambient arsenic contamination.
3. Educate local physicians on the symptoms, effects, and treatment regimes for arsenic exposure.
4. Consider reviewing pre-1979 cancer statistics to determine if cancer incidence was elevated prior to the time frame used in this analysis.

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## REFERENCES

1. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Arsenic. 1998.
2. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Mercury. 1998.
3. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Lead. 1998.

4. Wong O, Whorton MD, Foliart DE, Lowengart R. 1992. An ecologic study of skin cancer and environmental arsenic exposure. Int Arch Occup Environ Health 64:235-241
5. Schottenfeld, Fraumeni. 1996. Cancer epidemiology and prevention. New York: Oxford University Press. p. 1282-1330.

## TABLES

**Urinary Bladder Table 1.****Standardized Incidence Ratios using the Montana Population as a Reference, 1979-1999**

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	1	11.2	0.09	0.00	0.50
55-64	18	23.6	0.76	0.45	1.21
65-74	90	50.5	1.78¶	1.43	2.19
75+	68	61.7	1.10	0.86	1.40
20+ (all ages combined)	177	147.0	1.20¶	1.03	1.40

**Kidney**

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	9	12.5	0.72	0.33	1.23
55-64	15	14.9	1.00	0.56	1.56
65-74	30	22.9	1.31	0.88	1.81
75+	34	18.6	1.83¶	1.27	2.48
20+ (all ages combined)	88	68.9	1.28¶	1.02	1.56

**Liver**

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	2	1.8	1.11	0.12	4.01
55-64	5	2.0	2.50	0.81	5.83
65-74	6	4.9	1.22	0.45	2.67
75+	10	5.9	1.69	0.81	3.12
20+ (all ages combined)	23	14.6	1.58	1.00	2.36

**Lung**

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	57	40.2	1.42¶	1.07	1.84

55-64	127	110.6	1.15	0.96	1.37
65-74	210	194.2	1.08	0.94	1.24
75+	159	148.5	1.07	0.91	1.24
20+ (all ages combined)	553	493.5	1.12	1.03	1.22

## Prostate

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	11	14.5	0.76	0.38	1.24
55-64	87	91.5	0.95	0.76	1.03
65-74	212	232.3	0.91	0.79	1.04
75+	209	213.5	0.98	0.85	1.12
20+ (all ages combined)	519	551.8	0.94	0.86	1.02

## Skin

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	43	28.4	1.51	1.10	1.99
55-64	25	19.8	1.26	0.82	1.79
65-74	39	30.3	1.29	0.92	1.72
75+	39	39.8	0.98	0.70	1.31
20+ (all ages combined)	146	118.3	1.23	1.04	1.44

**Table 2.**

## Standardized Incidence Ratios using the U.S. population (SEER) as a Reference, 1979-1999 Urinary Bladder

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	1	15.2	0.07	0.00	0.37
55-64	18	28.5	0.60	0.37	1.00
65-74	90	62.8	1.40	1.15	1.76
75+	68	76.3	0.89	0.69	1.13
20+ (all ages combined)	177	182.8	0.97	0.83	1.12

## Kidney

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	9	14.9	0.60	0.28	1.03
55-64	15	18.8	0.80	0.45	1.23
65-74	30	29.0	1.04	0.70	1.43
75+	34	27.0	1.26	0.87	1.71
20+ (all ages combined)	88	89.7	0.98	0.79	1.20

## Liver

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
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20-54	2	5.2	0.39	0.04	1.39
55-64	5	7.0	0.71	0.23	1.66
65-74	6	12.3	0.49	0.18	1.06
75+	10	13.6	0.74	0.35	1.35
20+ (all ages combined)	23	38.2	0.60	0.38	0.90

## Lung

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	57	53.2	1.07	0.81	1.39
55-64	127	118.4	1.07	0.89	1.28
65-74	210	226.7	0.93	0.81	1.06
75+	159	195.0	0.82	0.69	0.95
20+ (all ages combined)	553	593.3	0.93	0.86	1.01

## Prostate

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	11	51.5	0.21	0.11	0.35
55-64	87	251.5	0.35	0.28	0.42
65-74	212	668.9	0.32	0.28	0.36
75+	209	666.2	0.31	0.27	0.36
20+ (all ages combined)	519	1638.25	0.32	0.29	0.34

## Skin

Age Categories	Observed	Expected	SIR	Lower 95% CI	Upper 95% CI
20-54	43	44.1	0.98	0.71	1.28
55-64	25	21.4	1.17	0.75	1.65
65-74	39	26.7	1.46 <sup>†</sup>	1.04	1.95
75+	39	25.4	1.54 <sup>†</sup>	1.09	2.05
20+ (all ages combined)	146	117.6	1.24 <sup>†</sup>	1.05	1.45

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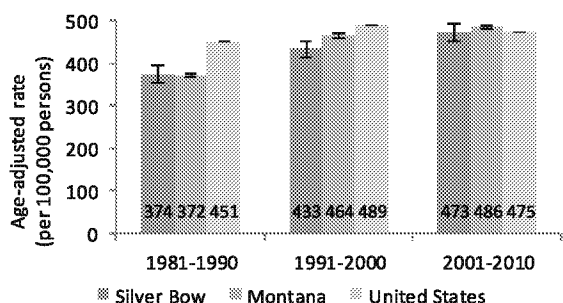
Agency for Toxic Substances and Disease Registry, 4770 Buford Hwy NE,  
Atlanta, GA 30341  
Contact CDC: 800-232-4636 / TTY: 888-232-6348





# Cancer Incidence in Silver Bow County, Montana, and the United States

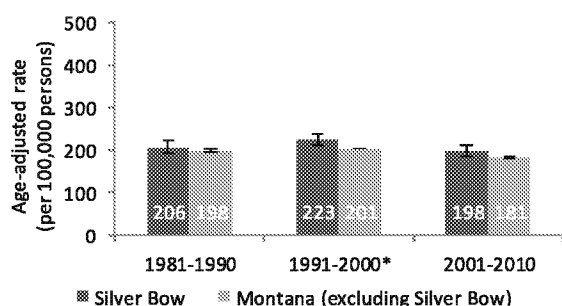
Figure 1. Age-adjusted incidence rate of all-site cancer, Silver Bow County, Montana and the U.S.



Cancer is a common disease in Montana and the United States. Approximately, 5,000 Montanans are diagnosed with cancer each year. A person can develop cancer for many reasons: genetics, environmental exposures, and life style behaviors (such as cigarette smoking, drinking alcohol, etc.). Unfortunately, however, it is often difficult to determine the exact cause for an individual's cancer.

The State of Montana has very complete data on cancer incidence. Cancer incidence is the number of newly diagnosed cancer cases each year. This data comes from the Montana Central Tumor Registry (MCTR). State law requires every case of cancer that is diagnosed or treated in Montana be reported to the MCTR (Montana Code Annotated 50.15.7). The MCTR has been collecting cancer data since 1979. The MCTR is very complete, over 95% of all cancer cases are in the registry.

Figure 2. Age-adjusted mortality rate of all-site cancer, Silver Bow County and Montana



Cancer incidence data for Montana and Silver Bow County was provided by the Montana Central Tumor Registry. Cancer incidence data for the United States was provided by the National Cancer Institute's Surveillance Epidemiology and End Results (SEER) program. Data on cancer mortality was provided by the Montana Office of Vital Statistics. All incidence and mortality rates in this report are age-adjusted to the U.S. Standard Million Population.

The incidence of cancer for all sites was the same among residents of Silver Bow County compared to the residents of the state of Montana (Figure 1). The U.S. all-site cancer incidence rate was higher than both Silver Bow County and Montana during the diagnosis period of 1981-1990 and 1991-2000 (Figure 1). The U.S. incidence rate was the same as Silver Bow County and Montana during the diagnosis period of 2001-2010 (Figure 1).

Mortality due to cancer (all-site) was the same in Silver Bow County as the rest of Montana for the periods 1981-1990 and 2001-2010 (Figure 2). The all-site cancer mortality rate for the period 1991-2000 was higher in Silver Bow County than the rest of Montana (Figure 2).

## MT Cancer Surveillance & Epidemiology Program

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Helena, Montana 59260-2951  
(406) 444-0064

<http://www.dphhs.mt.gov/publichealth/cancer/datastatistics.shtml>



May 2012



Figure 3. Incidence of prostate cancer among residents in Silver Bow County, Montana, and the U.S.

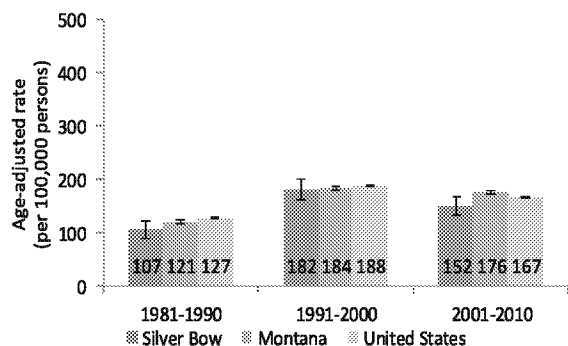


Figure 4. Incidence of breast cancer among female residents of Silver Bow County, Montana, and the U.S.

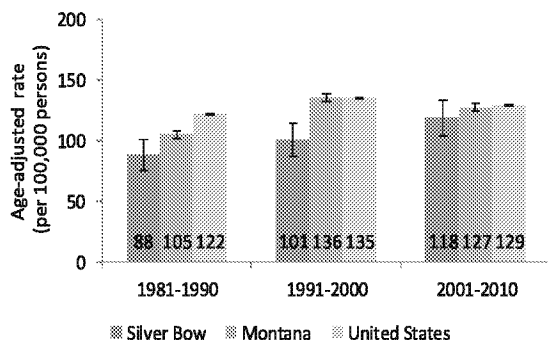


Figure 5. Incidence of colorectal cancer among residents of Silver Bow County, Montana, and the U.S.

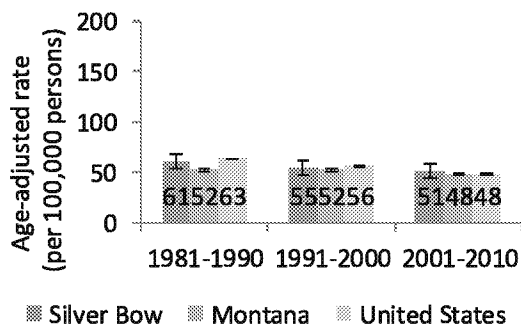
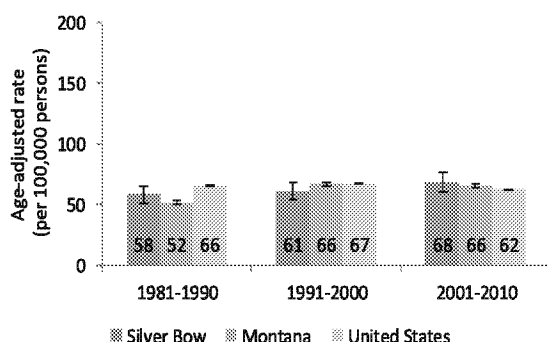


Figure 6. Incidence of lung & bronchus cancer among residents in Silver Bow County, Montana, and the U.S.



## Incidence of the Most Common Cancers

The most common types of cancer in Silver Bow County are also the most common in Montana and in the United States. None of these cancers (except for lung cancer) are known to be affected by the heavy metals or chemicals of concern in Silver Bow County. Lung cancer is also associated with arsenic exposure. However the majority of lung cancer cases are caused by cigarette smoking (87% of cases among men and 74% of cases among women).

### Prostate Cancer Incidence

Prostate is the most diagnosed cancer in Montana and in the US. The incidence of prostate cancer among residents of Silver Bow County was the same as Montana and the United States for the time intervals 1981-1990 and 1991-2000 (Figure 3). From 2001-2010, the incidence rate in Silver Bow County was lower than Montana (Figure 3).

### Female Breast Cancer Incidence

The incidence of female breast cancer among residents of Silver Bow County was lower than Montana and the United States for the time periods 1981-1990 and 1991-2000 (Figure 4). From 2001-2010, the incidence rate in Silver Bow County was the same as Montana and the United States (Figure 4).

### Colorectal Cancer Incidence

The incidence of colorectal cancer among residents of Silver Bow County was the same as Montana and the United States for all three time intervals (Figure 5).

### Lung & Bronchus Cancer Incidence

The incidence of lung & bronchus cancer was the same among residents of Silver Bow County and Montana for all three time intervals (Figure 6).

## Mortality of the Most Common Cancers

### Prostate Cancer Mortality

Mortality due to prostate cancer among residents of Silver Bow County was the same as Montana for all three time intervals (Figure 7).

### Female Breast Cancer Mortality

Mortality due to female breast cancer among residents of Silver Bow County was the same as the rest of Montana for all three time intervals (Figure 8).

### Colorectal Cancer Mortality

Mortality due to colorectal cancer among residents of Silver Bow County was higher than the rest of Montana for all three time intervals (35% higher in 1981-90, 50% higher in 1991-00, and 50% higher in 2001-10) (Figure 9).

### Lung & Bronchus Cancer Mortality

Mortality due to lung & bronchus cancer was the same among residents of Silver Bow County as the rest of Montana for all three time intervals (Figure 10).

Figure 7. Mortality of prostate cancer among residents in Silver Bow County and Montana

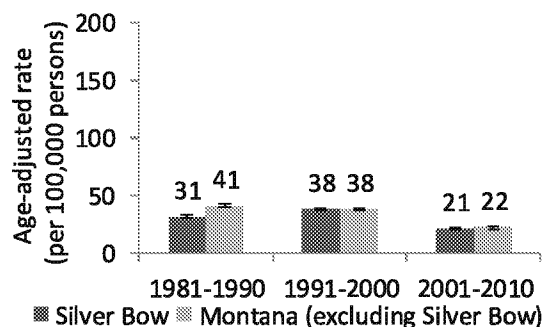


Figure 8. Mortality of female breast cancer among residents of Silver Bow County and Montana

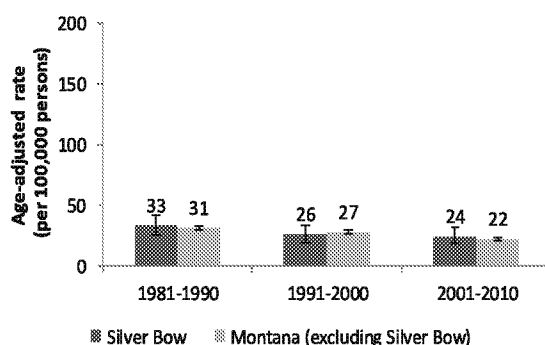


Figure 9. Mortality of colorectal cancer among residents of Silver Bow County and

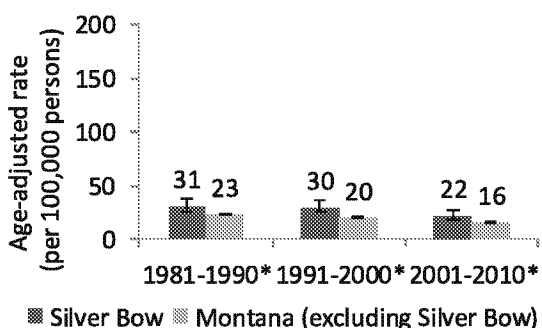


Figure 10. Mortality of lung & bronchus cancer among residents in Silver Bow County

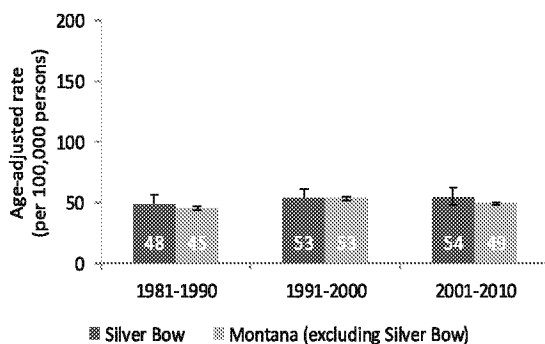


Figure 11. Incidence of bladder cancer among residents of Silver Bow County, Montana, and the U.S.

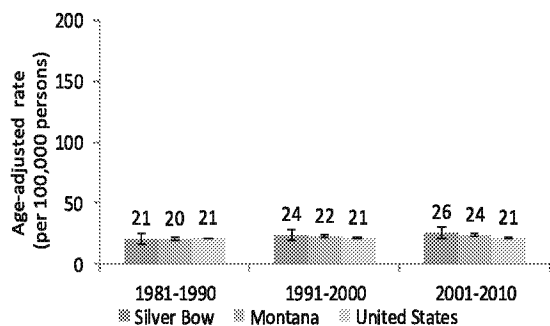


Figure 12. Mortality of bladder cancer among residents of Silver Bow County and Montana

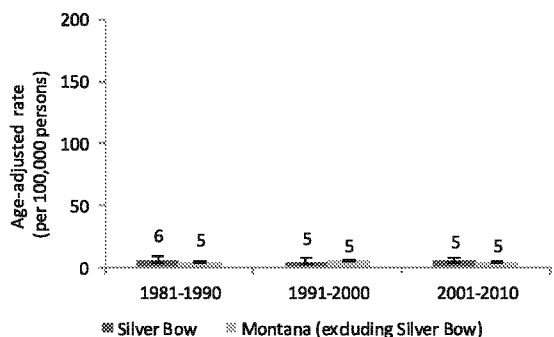
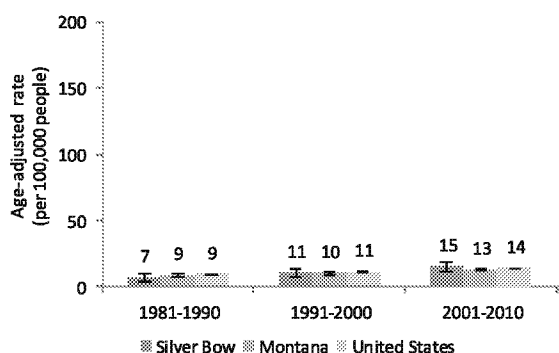


Figure 13. Incidence of kidney cancer among residents of Silver Bow County, Montana, and the U.S.



## Cancers associated with Environmental exposures

Assessing cancer risk of humans due to exposure to environmental compounds requires the review of multiple scientific studies. These studies assess cancer risk in humans, animals, and in the laboratory. National and international agencies use the results of these studies to classify environmental compounds as to their cancer-causing potential. The International Agency for Research on Cancer (IARC) and the Agency for Toxic Substances and Disease Registry (ATSDR) have classified the carcinogenicity of the following heavy metals and chemical of concern in Silver Bow County:

**Arsenic:** *Carcinogenic to humans (Group 1)*

**Inorganic Lead:** *Probably carcinogenic to humans (Group 2A)*

**Organic Lead:** *Not classifiable as to its carcinogenicity to humans (Group 3)*

**Metallic Mercury & Inorganic Mercury:** *Not classifiable as to its carcinogenicity to humans (Group 3)*

**Methylmercury compounds:** *Possibly carcinogenic to humans (Group 2B)*

**Pentachlorophenol (PCP):** *Possibly carcinogenic to humans (Group 2B)*

### Arsenic Exposure

Cancers known to be associated with arsenic exposure (via food or water contamination) include lung & bronchus, bladder, kidney, and skin cancer (squamous cell carcinoma). Squamous cell carcinoma of the skin is not a reportable cancer by Montana State Law. The MCTR does not have complete data on the incidence of this type of skin cancer, therefore it is not reported here.

### Lung & Bronchus cancer

The incidence of lung & bronchus cancer was the same among residents of Silver Bow County and Montana for all three time periods (Figure 6). Mortality due to lung & bronchus cancer was the same among residents of Silver Bow County and as the rest of Montana for all three time intervals (Figure 10).

### Bladder Cancer

The incidence of bladder cancer among residents of Silver Bow County is the same as Montana and the United States during each of the three time periods (Figure 11). Mortality due to bladder cancer was the same in Silver Bow County as the rest of Montana for three time intervals (Figure 12).

### Kidney Cancer

The incidence of kidney cancer among residents of Silver Bow County is the same as Montana and the United States during each of the three time periods (Figure 13). There were too few deaths due to kidney cancer in Silver Bow County during the time intervals 1981-90 and 1991-00 to compute a rate (14 and 16 deaths, respectively). From 2001-2010 mortality due to kidney cancer in Silver Bow County was the same as the rest of Montana (Figure 14).

### Pentachlorophenol (PCP) Exposure

Pentachlorophenol is possibly carcinogenic to humans (Group 2B). There is inconclusive evidence of cancer in humans. However, increases in liver, adrenal gland, and nasal tumors have been found in lab animals. Cancers of the adrenal gland and the nasal cavity had too few cases in Silver Bow County to report.

### Liver Cancer

The incidence of liver cancer was the same among residents of Silver Bow County, Montana and the United States during the time intervals of 1991-00 and 2001-10 (Figure 15). There were too few cases of liver cancer during the 1981-90 time interval to calculate a rate. There were too few deaths due to liver cancer in Silver Bow County to calculate a rate during all three time intervals. The mortality rate of liver cancer in Montana remained the same during all three time intervals (Figure 16).

Figure 14. Mortality of kidney cancer among residents of Silver Bow County and Montana

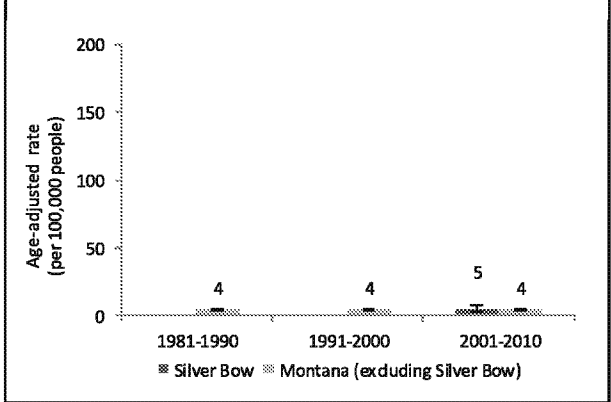


Figure 15. Incidence of liver cancer among residents of Silver Bow County, Montana, and the U.S.

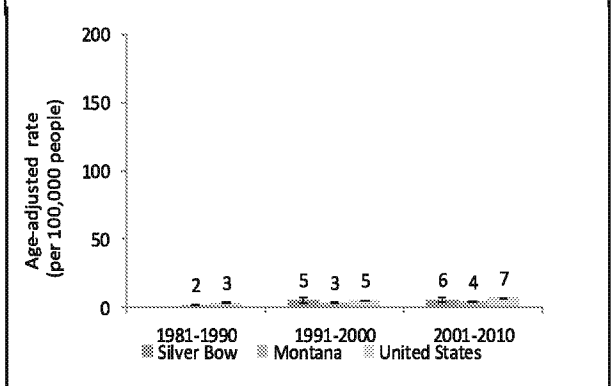


Figure 16. Mortality of liver cancer among residents of Silver Bow County and Montana

